IN THE CLAIMS

1. (Original) An optical amplifier comprising:

input means for receiving input optical signals;

beam generating means for generating pump beams; and

waveguide means for receiving the optical signals from the input means, and pump beams from the beam generating means, the waveguide means being arranged to absorb the received pump beams and operable to amplify the received optical signal using stimulated emission of radiation, the pump beams being used to drive the waveguide means to provide the stimulated emission;

wherein the beam generating means is a vertical cavity surface emitting laser.

2. (Original) An optical amplifier according to claim 1, further comprising routing means for receiving the input optical signals from the input means, and pump beams from the beam generating means, and for routing the received input optical signals and the pump beams to the waveguide means.

3. (Original) An optical amplifier according to claim 2, wherein the routing means comprises a glass or sapphire substrate.

4. (Currently Amended) An optical amplifier according to claim 2 [[or 3]], wherein the routing means includes collimating and focusing means.

5. (Original) An optical amplifier according to claim 4, wherein the collimating and focusing means comprise a microlens array.

6. (Original) An optical amplifier according to claim 4, wherein the collimating and focusing means comprise diffractive optical elements.

7. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, further comprising monitoring means for monitoring the power of the optical signals and the pump beams.

8. (Original) An optical amplifier according to claim 7, wherein the monitoring means is a two-dimensional photodetector array.

9. (Original) An optical amplifier according to claim 8, wherein the vertical cavity surface emitting laser is an integrated circuit, integrated with the photodetector array.

10. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, wherein the input means has a multi-port configuration.

11. (Original) An optical amplifier according to claim 10, wherein the input means comprises an array of optical fibres.

12. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, wherein the waveguide means has a multi-port configuration.

13. (Original) An optical amplifier according to claim 12, wherein the waveguide means comprises an array of optical fibres.

14. (Original) An optical amplifier according to claim 13, wherein the fibres in the array of optical fibres are either core-pumped or cladding-pumped.

15. (Currently Amended) An optical amplifier according to claim 13 [[or 14]], wherein the array of optical fibres comprises erbium-doped alumino-silicate fibres, or praseodymium-doped fluoride fibres.

16. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, wherein the vertical cavity surface emitting laser operates in transverse single-mode.

17. (Currently Amended) An optical amplifier according to ~~any one of claims 1 to 15~~ claim 1, wherein the vertical cavity surface emitting laser operates in multi-mode.

18. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, wherein the vertical cavity surface emitting laser is arranged with an external cavity resonator.

19. (Currently Amended) An optical amplifier according to ~~any preceding~~ claim 1, further comprising a first detecting means for detecting pump beam signals, and a processor to which pump beam monitoring signals are supplied, from the first detecting means, in response to the detected pump signals, the processor being operable to generate control signals for controlling the pump beam generating means, in response to the pump beam monitoring signals.

20. (Original) An optical amplifier according to claim 19, wherein the first detecting means is a photodetector array integrated on a semiconductor chip.

21. (Currently Amended) An optical amplifier according to claim 19 [[or 20]], further comprising a second detecting means for detecting the input signal beams, with input monitoring signals being supplied from the second detecting means to the processor in response to detected input signals, the processor being operable to generate control signals for controlling the beam generating means, in response to received input monitoring signals, and pump beam monitoring signals.

22. (Original) An optical amplifier according to claim 21, wherein the second detecting means is a photodetector array.

23. (Original) An optical amplifier comprising:

an optical substrate having top and bottom faces and two side faces extending between the top and bottom faces so that the substrate has a square-shaped cross-section;

an input fibre array and an output doped fibre array respectively coupled to the side faces in alignment with each other, the input fibre array supplying input beams;

a vertical cavity surface emitting laser (VCSEL) array and a top photodetector array arranged in series proximate to the top face, the VCSEL array generating pump beams;

a bottom photodetector arranged proximate to the bottom face in alignment with the VCSEL array and the top photodetector array;

a routing element arranged in the substrate at 45° to the side faces having a beam splitting lower surface and a reflective upper surface, the lower surface transmitting a major portion of the input beams to the output doped fibre array and reflecting a minor portion of the input beams to the bottom photodetector array, the upper surface reflecting the pump beams to the output doped fibre array; and

a processor for adjusting the power level of the pump beams in response to the power levels detected by the top and bottom photodetector arrays so that the gain of the optical amplifier can be selectively controlled.

24. (Original) An optical amplifier according to claim 23, further comprising an input microlens array etched in the optical substrate for collimating the input beams.

25. (Currently Amended) An optical amplifier according to claim 23 [[or 24]], further comprising an output microlens array etched in the optical substrate for coupling the input beams and the pump beams to the output doped fibre array.

26. (Currently Amended) An optical amplifier according to ~~any one of claims 23 to 25~~ claim 23, wherein the bottom photodetector array is flip-chip bonded to the optical substrate.

27. (Currently Amended) An optical amplifier according to ~~any one of claims 23 to 26~~ claim 23, wherein the VCSEL array is flip-chip bonded with an Ultra-Thin Semiconductor (UTS) chip that integrates the top photodetector array.

28. (Currently Amended) An optical amplifier according to ~~any one of claims 23 to 27~~ claim 23, wherein the output doped fibre array is an erbium doped fibre array.

29. (Currently Amended) An optical amplifier according to ~~any one of claims 23 to 28~~ claim 23, wherein the optical substrate comprises a glass or sapphire substrate.

30. (Original) A method for controlling the optical gains of an optical amplifier, the amplifier comprising at least one optical fibre amplifier and a pump source, the method comprising the steps of:

measuring the power of pump beams generated by the pump source and deriving a first signal representative thereof;

measuring the power of input optical signals and deriving a second signal representative thereof;

estimating the signal gain based on the measured input signal power and pump power, and deriving a third signal representative of the difference between the measured signal gain and the desired signal gain;

processing the first, second, and third signals to generate a pump source driving current profile in response to the processed first, second and third signals; and

controlling the generation of driving current profile to achieve the desired output power for the pump beam.

31. (Cancelled)

32. (Cancelled)